Jun 4th, 1:30 PM

Cygnus and the Future of LEO Commercialization & Deep Space Exploration

Bob Richards
Vice President, Strategy and Business Development Space Systems Division, Northrop Grumman

THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

Cygnus and the Future of LEO Commercialization & Deep Space Exploration

June 4, 2019

Bob Richards
Vice President
Strategy & Business Development
Civil and Commercial Satellites

Northrop Grumman Innovation Systems

- Northrop Grumman Innovation Systems Sector designs, builds and delivers space, defense and aviation-related systems to customers around the world. Our main products include launch vehicles and related propulsion systems; missile products, subsystems and defense electronics; precision weapons, armament systems and ammunition; satellites and associated space components and services; and advanced aerospace structures.

- Good Synergy with other Northrop Grumman Sectors. Scale and depth to meet complex mission Needs

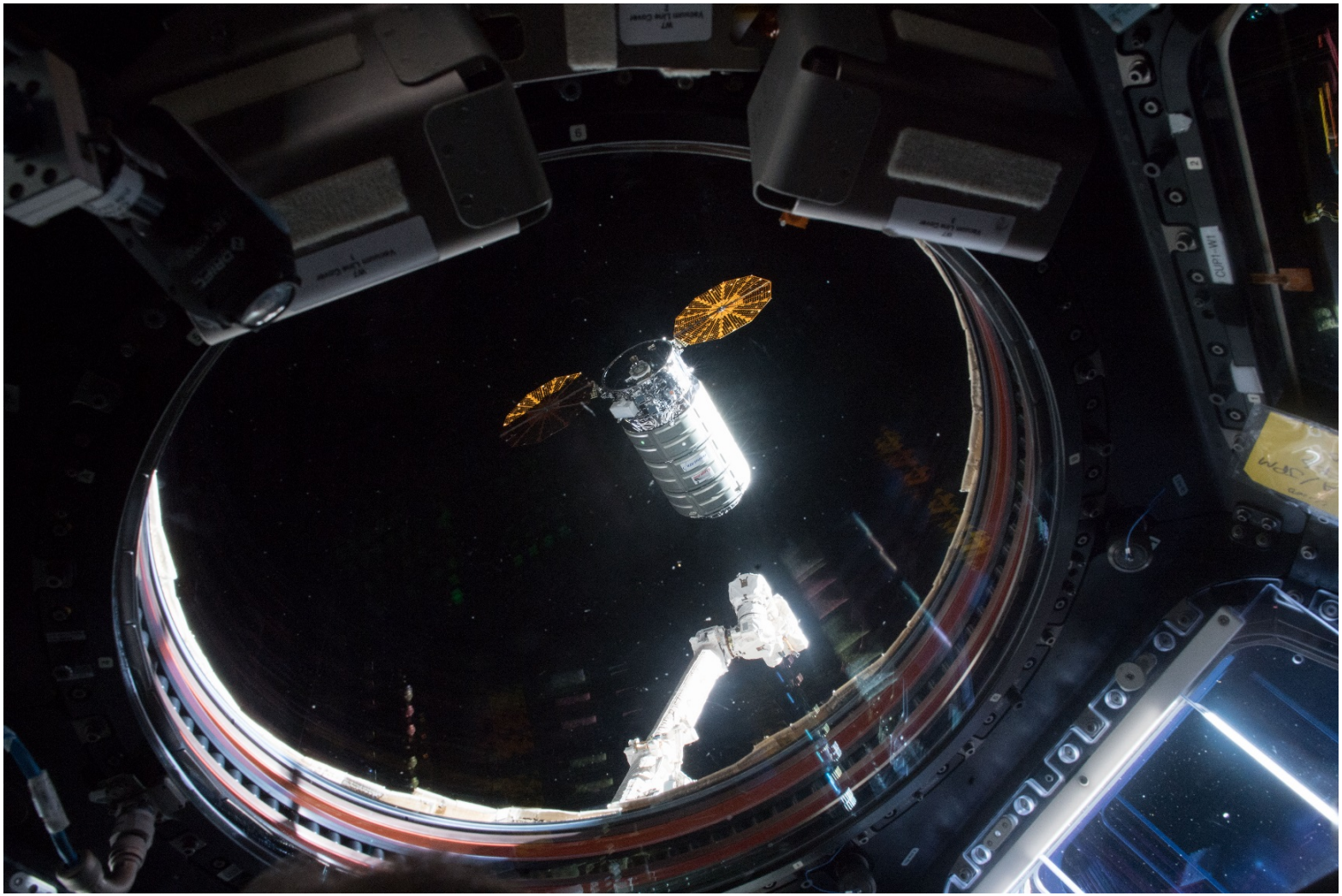
- Quick Facts About the Sector:
  - Headquarters: Dulles, Virginia (Washington, D.C. area)
  - Approximately 15,000 Employees
  - Facilities in 18 states and several overseas locations

Cygnus Commercial Cargo Vehicle

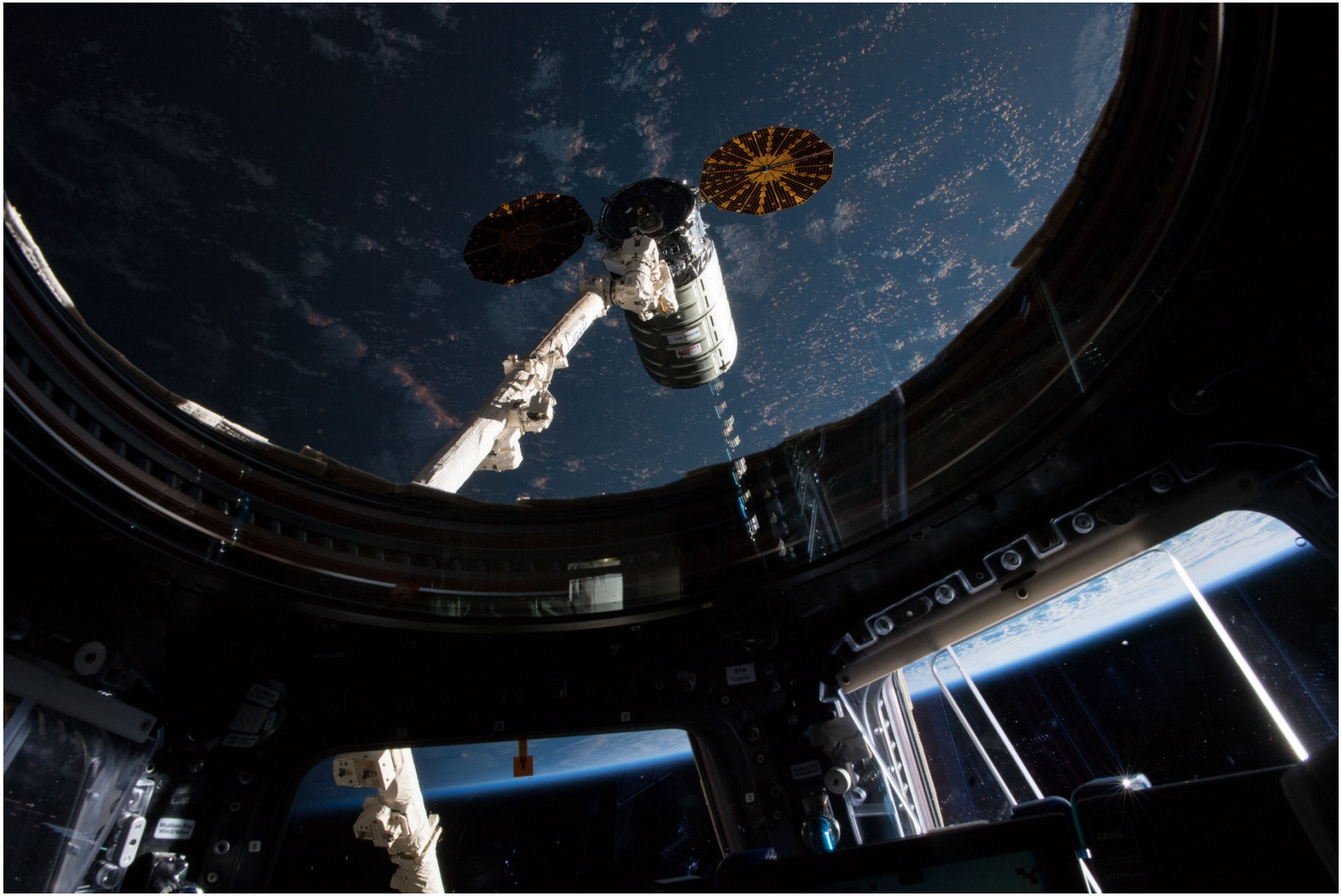
- Northrop Grumman is the prime contractor and developer of the Cygnus spacecraft, providing logistics support to the ISS under NASA's Cargo Resupply Service (CRS) contract, including commercial and science payloads
- It is a semi-autonomous delivery system for pressurized and unpressurized payloads and cargo, that meets NASA's human rating requirements
- Flight-proven low-risk design with eleven successful flights to the ISS to date
- Evolvable and multi-mission platform for future support of deep-space exploration and commercialization in low Earth orbit

Nearing the International Space Station

Cygnus Flies Autonomously to Capture Point



Cygnus Ready for Capture (10 meters from ISS)

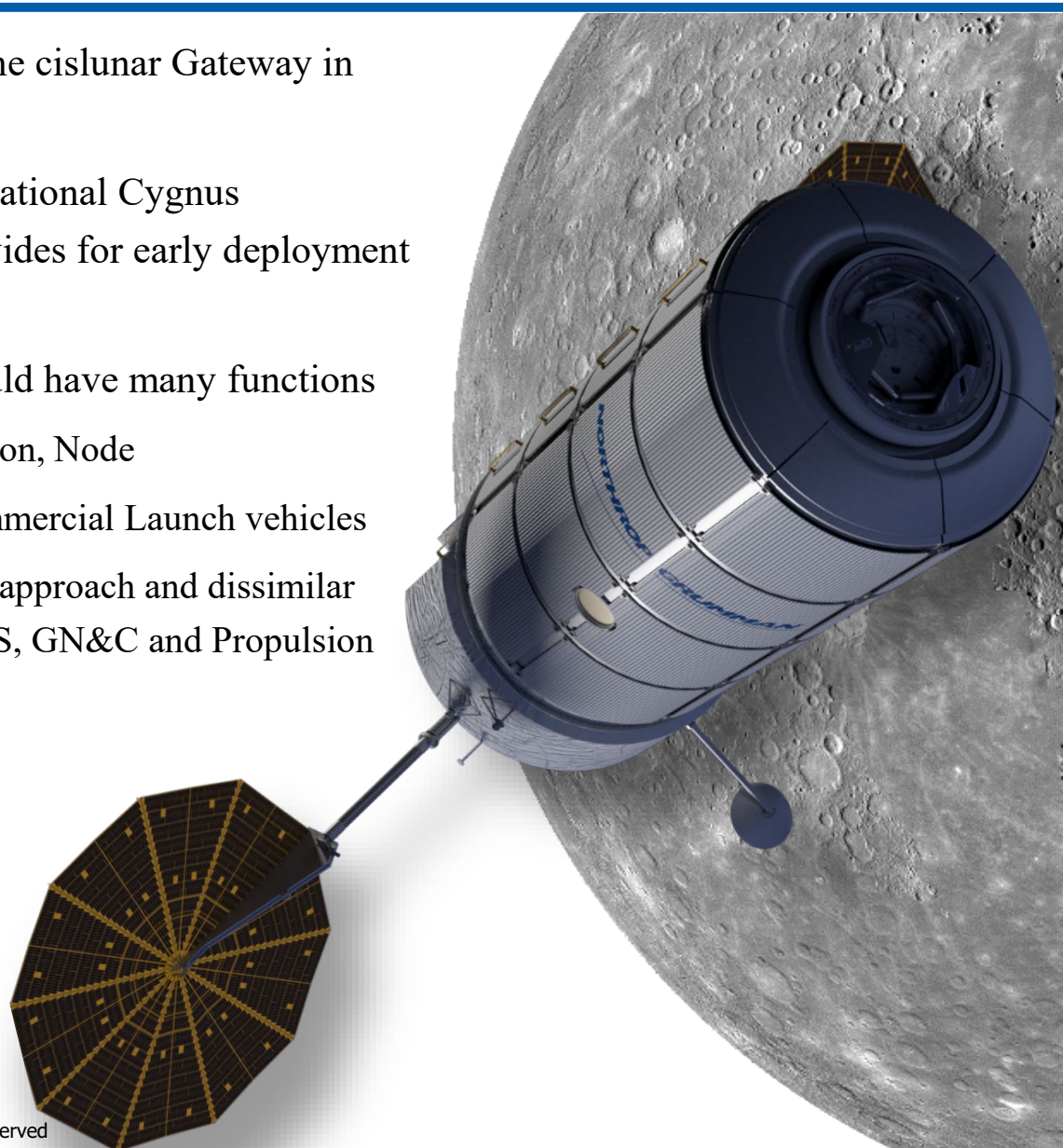


Cygnus Grappled by the ISS Astronauts

NORTHROP GRUMMAN

Cygnus Provides a Basis for Deep-Space Exploration

- Cygnus derived vehicles can support the cislunar Gateway in many ways
- Leverages NG's human-rated and operational Cygnus commercial cargo vehicle, which provides for early deployment and operations in cislunar space
- Cygnus-derived Gateway Modules could have many functions
  - Logistics, Habitat, Science Utilization, Node
  - Self Delivery Capability using Commercial Launch vehicles
  - Provides a modular and distributed approach and dissimilar back up for Gateway power, ECLSS, GN&C and Propulsion
- Architecture approach advocates flexibility, modularity and distributed functionality

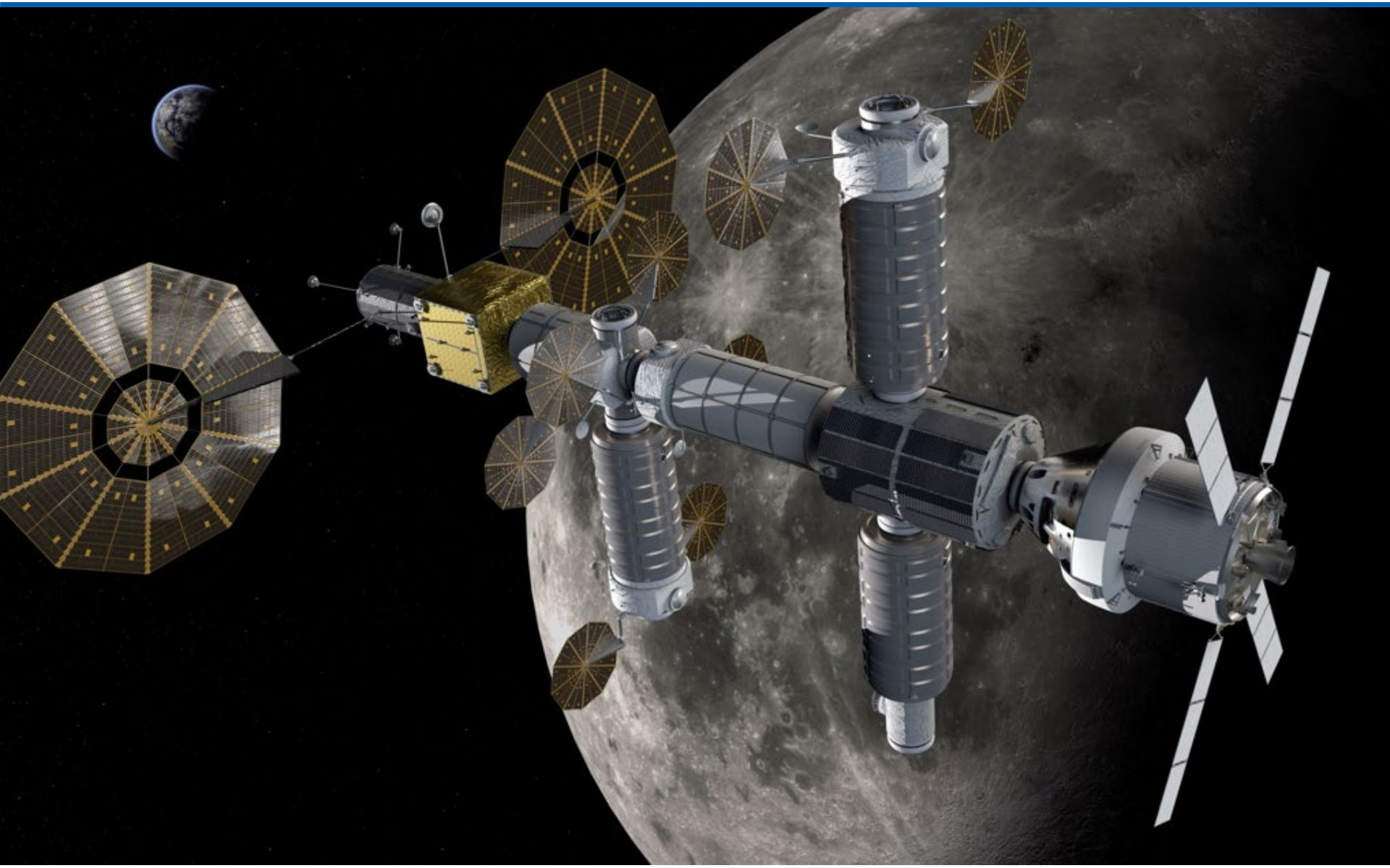


Gateway Mock-up

NG's Habitat and Augmentation Module mock-ups are undergoing day-in-the-life testing at Johnson Space Center

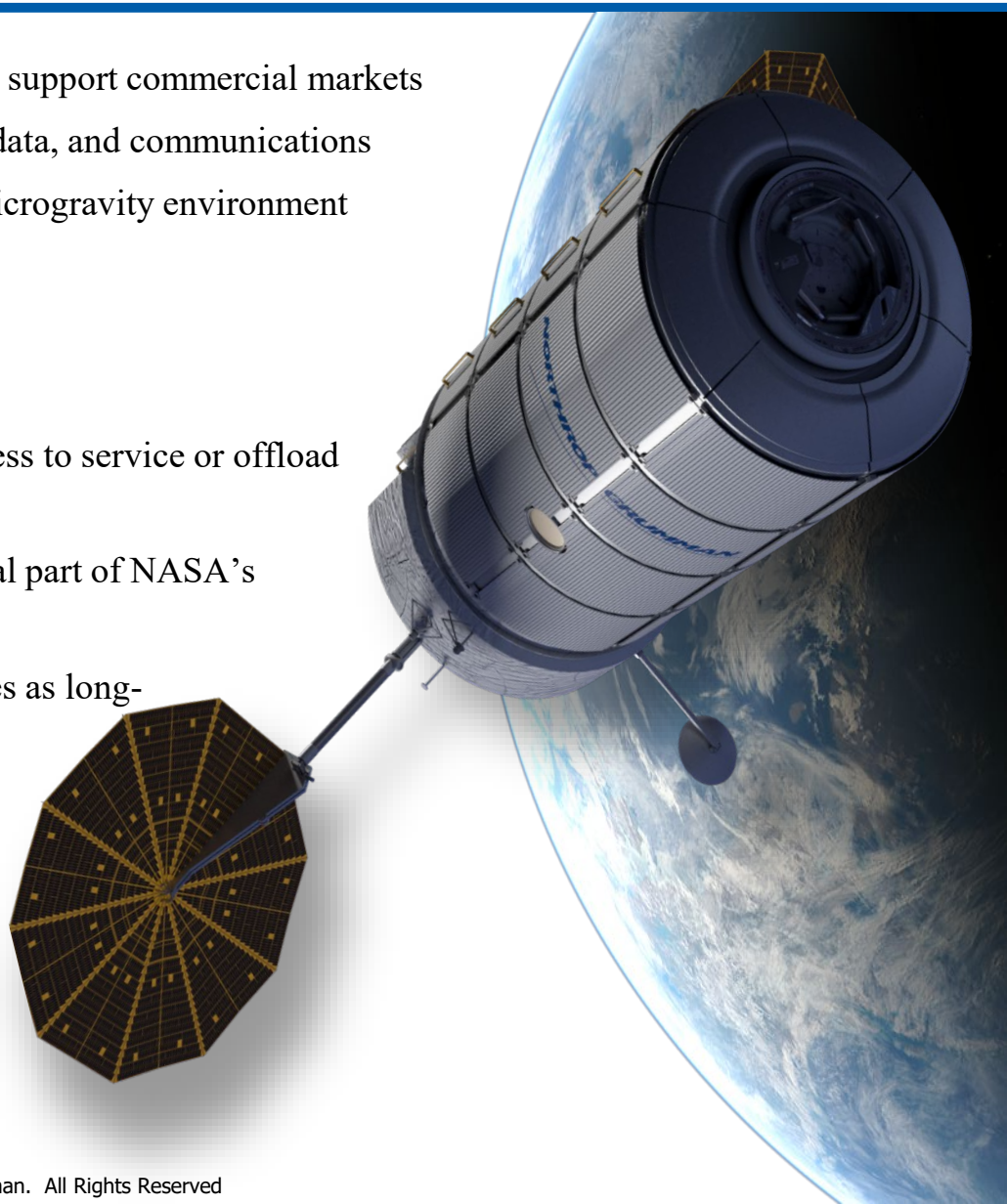
1. 4.4-meter diameter Habitat
2. 3-meter diameter Augmentation Module
3. Airlock/Tunnel
4. Mockup Support / Test Area.

Northrop Grumman Cislunar Gateway



Future Support to LEO Commercialization

- Cygnus Capabilities are continuously improving to support commercial markets
  - Enhanced interface services such as power, data, and communications
  - Long-duration missions in an undisturbed microgravity environment
  - Additional payload deployment options
- Developing a Cygnus Lab platform for payloads
  - Free-flight or attached operations
  - Ability to return to ISS – allow for crew access to service or offload payloads
- Cygnus and Cygnus-derived vehicles are an integral part of NASA's Commercialization of LEO efforts
  - Cygnus variants and Cygnus-derived vehicles as long-duration commercial platforms
  - Synergy with Beyond-LEO vehicles



Northrop Grumman Commercial LEO Platform

NORTHROP GRUMMAN

THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN